

Current research group

1. Anitha S. (Part time-Thesis submitted)



Anitha S
Scientific officer,
VSSC,ISRO,India

Research interest:

- Synthesis of non-isocyanate polyurethanes (NIPU) utilizing CO₂ and investigating the properties of the resulting cyclic carbonate
- Synthesis of NIPU from cyclic carbonate (CC) followed by its characterization and exploring the possible applications in various field such as medical, aerospace, construction, house hold articles etc

Research area:

Thesis Title: Investigations on non-isocyanate polyurethanes

- Synthesis of partially and fully converted cyclic carbonate from DGEBA. Investigating its properties and exploring its applicability by incorporating the developed partially converted CC into inherently brittle epoxy-amine system. The system was studied in detail
- A hybrid PHU was synthesized from an aliphatic and aromatic CC cured with an amine. The hybrid system shows thermos-reversible adhesion as well as good adhesive strength with low energy substrates (nylon, HDPE)
- The study also resulted in the development of NIPU foam *via*. CO₂ incorporation on an epoxy system. The morphological and mechanical properties were evaluated using the standard methods
- A hybrid functional monomer containing both epoxy as well as cyclic carbonate, was synthesized by incorporating CO₂ under suitable experimental conditions. The NIPU synthesized from it possess very good mechanical and morphological features

Publications

1. **S. Anitha**, K.P. Vijayalakshmi, G. Unnikrishnan, Santhoshkumar, CO₂ Derived Hydrogen Bonding Spacer: Enhanced Toughness, Transparency, Elongation and Non-covalent Interactions in Epoxy-Hydroxyurethane Networks, *J. Mater. Chem.A*, 2017, 5, 24299–24313.

2. **S. Anitha**, C. Suchithra, Nisha Balachandran, G. Unnikrishnan and K S. Santhosh Kumar, Hybrid poly (hydroxy urethane)s; folded sheet morphology and thermo-reversible adhesion, *ACS Omega*, DOI.org/10.1021/acsomega.9b00789, 2019

2. Satheesh Kumar B. (Part time-Thesis submitted)



Research interest:

- Polymer synthesis
- Proton exchange membranes
- Polymer nanocomposites
- Polymer blends
- High performance polymers
- Vitrimers

Research area:

Thesis Title: Studies on polybenzimidazoles and their nanocomposites for fuel cell membrane applications.

- Synthesis of low molecular weight PBI powders (by varying the reaction parameters), and their characterization.
- Preparation of composite membranes by using PBI powder as a proton hopping unit in a film forming polymer, and their characterization.
- Synthesis of a high molecular weight PBI and its nanocomposite membranes with high conductivity, and their characterization.
- Synthesis of PBI blends as well as PBI co-polymers containing aliphatic and aromatic units in the backbone in order to fine-tune the properties.
- Development of optimized membranes with low doping level and high conductivity.

Publications

1. **B. Satheesh Kumar**, Dona Mathew, G. Unnikrishnan, Tushar Jana, Santhosh Kumar K.S., Polybenzimidazole – nanocomposite membranes: Enhanced proton conductivity with low content of amine-functionalized nanoparticles, *Polymer*, 2018, 145, 434-446
2. **B. Satheesh Kumar**, B. Sana, G. Unnikrishnan, T. Jana and K. S. Santhosh Kumar, Nano-ordered aromatic/alicyclic polybenzimidazole blend membranes, *React. Funct. Polym.*, 10.1016/j.reactfunctpolym.2019.06.020, 2019
3. **B. Satheesh Kumar**, B. Sana, G. Unnikrishnan, Tushar Jana and K. S. Santhosh Kumar, Polybenzimidazole as proton conducting filler in polydimethylsiloxane: Enhanced oxidative stability and membrane properties, *J. Appl. Polym. Sci.*, 136,48151-48159, 2019
4. **B. Satheesh Kumar**, Balakondareddy Sana, G. Unnikrishnan, Tushar Jana and K. S. Santhosh Kumar, Polybenzimidazole co-polymers: their synthesis, morphology and high temperature fuel cell membrane properties, *Polym. Chem.*, 10.1039/C9PY01403A, 2019

3. Lashmi P.G. (External-Thesis submitted)



Research interest:

- High performance thermal barrier coatings (TBC) and environmental barrier coatings (EBC)
- Thermal spray techniques- atmospheric plasma spraying (APS), high velocity oxy fuel (HVOF) and suspension plasma spraying (SPS)
- Synthesis of flowable ceramic oxide powders by chemical routes such as solution combustion synthesis (SCS), co-precipitation, spray drying process

Research area:

Thesis Title: Studies on double ceramic layered atmospheric plasma sprayed La₂Ce₂O₇/YSZ thermal barrier coatings

- Synthesis of plasma grade oxide powders such as La₂Ce₂O₇ (LCO), 8YSZ- Ln₂O₃ (Ln: Dy, Gd) and also YSZ at laboratory scale through various techniques such as single-step solution combustion, two-step co-precipitation and multi-step spray drying processes
- Optimization of the process parameters employed to synthesize flowable, micron-sized ceramic particles
- Fabrication YSZ/LCO, YSZ-Ln₂O₃/LCO bilayer TBCs by atmospheric plasma spraying technique
- Testing (mainly for hot corrosion and CMAS attack) and validation of the fabricated coatings

Publications

1. **P. G. Lashmi**, N. Balaji, K. Anil Kumar, G. Unnikrishnan, P. V. Ananthapadmanabhan, S. T. Aruna, Solution combustion synthesis of calcia-magnesia-aluminosilicate powder and its interaction with yttria -stabilized zirconia and cluster paired yttria-stabilized zirconia, *Ceramics International* 45(2019) 18255-18264.
2. **P. G. Lashmi**, G. Unnikrishnan, P. V. Ananthapadmanabhan, S. T. Aruna, Present status and future prospects of plasma sprayed multilayered thermal barrier coating systems, *Journal of European Ceramic Society*, Article ID: JECD-D-19-00779RI, Article under review.
3. **P. G. Lashmi**, P. V. Ananthapadmanabhan, Y. Chakravarthy, G. Unnikrishnan, N. Balaji, S. T. Aruna, Hot corrosion studies on plasma sprayed bilayer YSZ/La₂Ce₂O₇ thermal barrier coating fabricated from synthesized powders, *Journal of Alloys and Compounds*, 711(2017) 3555-364.

4. Rarima R.



Research interests:

- Biocomposites
- Nanomaterials
- Catalysis
- Sensing
- Inorganic chemistry

Research area:

Influence of additives on the properties and applications of Poly(lactic acid)

- Fabrication of porous membranes and foams
- Evaluation of biocompatibility of porous poly(lactic acid) membranes and foams
- A study on the catalytic effect of silver/poly(lactic acid) composites
- Poly(lactic acid) composites for biomedical applications

Publications

1. **R. Rarima**, R. Asaletha, G. Unnikrishnan (2018) Schiff base-assisted surface patterning of polylactide–zinc oxide films: generation, characterization and biocompatibility evaluation. J Mater Sci 53: 9943 - 9957
2. **R. Rarima**, G. Unnikrishnan (2020) Porous poly(lactic acid)/nano-silver composite membranes for catalytic reduction of 4-nitrophenol. Mater. Chem. Phys. 241: 122389

5. Shafeeq V.H.



Research interest:

- Polymer blends and composites
- Synthesis Modification and analysis of Phenolic resole resins
- Resin/formulation improvement for coated abrasives' application
- Polymer Coatings and Adhesive

Research area:

Polyurethane (PU) Ethylene-co-Vinylacetate (EVA) blends Modified with Biological Nanofillers

- Synthesis of nanofillers through wet chemical method
- Development of nanofiller loaded PU/EVA systems
- Evaluation of mechanical, thermal, morphological and sensing properties of PU/EVA nanocomposites
- Fabrication of suitable devices for sensing applications
- Fine tuning of performance of the composite systems through various fabrication techniques

6. Noorudheen P.



Research interest:

- Polymer synthesis
- preparation and characterization of polymer blends
- Polymer/inorganic hybrid materials
- polymer nanocomposites
- Development of biodegradable polymers

Research area:

Synthesis of carbazole based conjugated polymeric systems for optical and sensing applications

- Synthesis of carbazole based polymers
- Characterization of the synthesized polymers by different analytical techniques
- Investigation of the application in organic electronics and sensing.

7. Jasmin Joseph (Part time)



Research interest:

- Preparation and characterization of polymers for biomedical applications
- Electrospinning of polymers and polymer composites
- Mechanical characterization of polymeric materials
- Degradation studies of polymers

Research area:

Preparation and characterisation of polymer based scaffold for tympanic membrane repair

- Synthesis of polymer blends
- Fabrication of electrospun scaffold using natural/synthetic polymers or polymer blends
- Effect of reinforcing agents on the mechanical properties of scaffold
- Physico chemical characterization of polymers and scaffolds
- Preparations of polymer scaffold using other fabrication techniques such as freeze drying, solvent casting etc and its comparison with electrospun scaffold
- Preparation of tissue engineered scaffold for Tympanic Membrane Repair